



WESTCARB Phase II Northern Arizona Saline Formation CO₂ Storage Pilot Test

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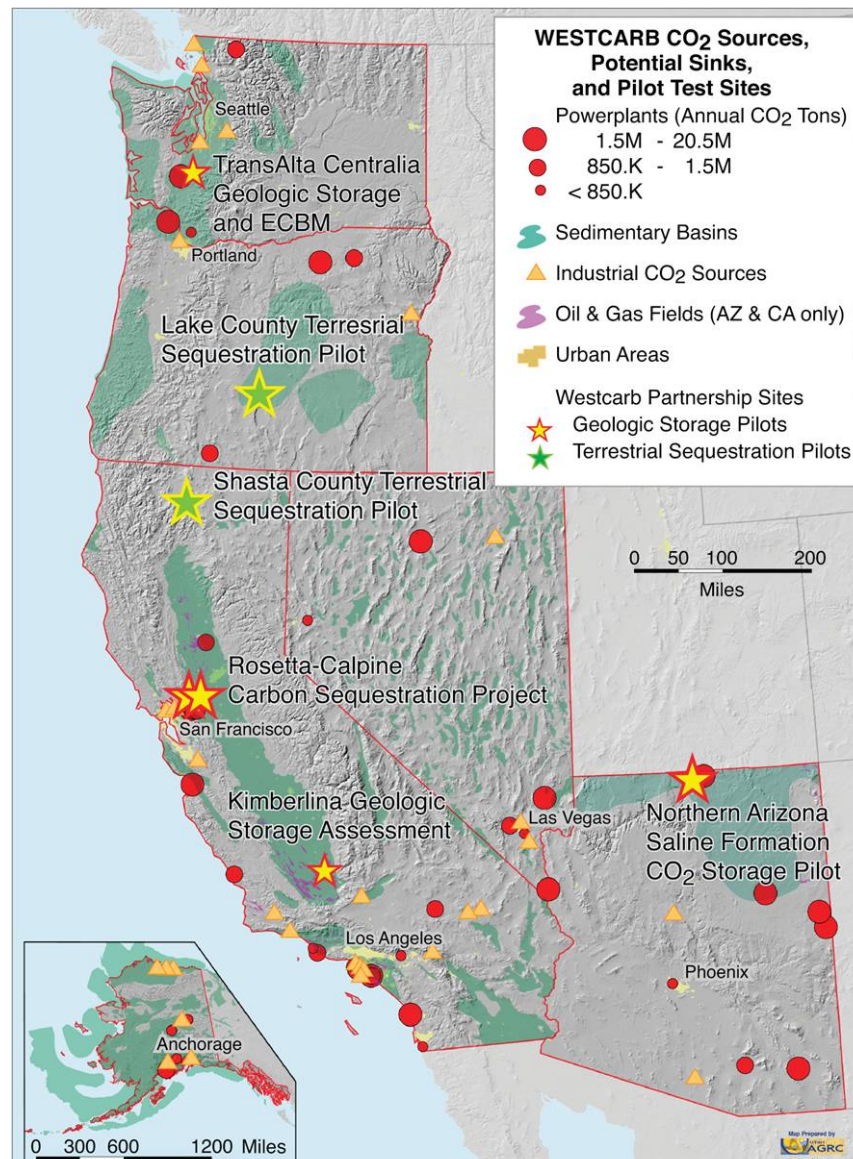
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October 4, 2006



WESTCARB Geologic Storage Pilots

- Northern Arizona Saline Formation CO₂ Storage Pilot
- Partners
 - Salt River Project
 - EPRI
- 30-40 Mt CO₂ sources from coal-fired power plants
 - Navajo Generating Station
 - Coronado Generating Station
 - Springerville Generating Station
- Focus on siting for future power plants



Phased Approach to the Pilot Test

- Phase I. Pre-pilot planning, geologic characterization and outreach
- Phase II. Characterization, detailed pilot project planning and permitting
- Phase III. CO₂ injection, monitoring and storage assessment

Options

Site
Assessment

Injection and
Monitoring

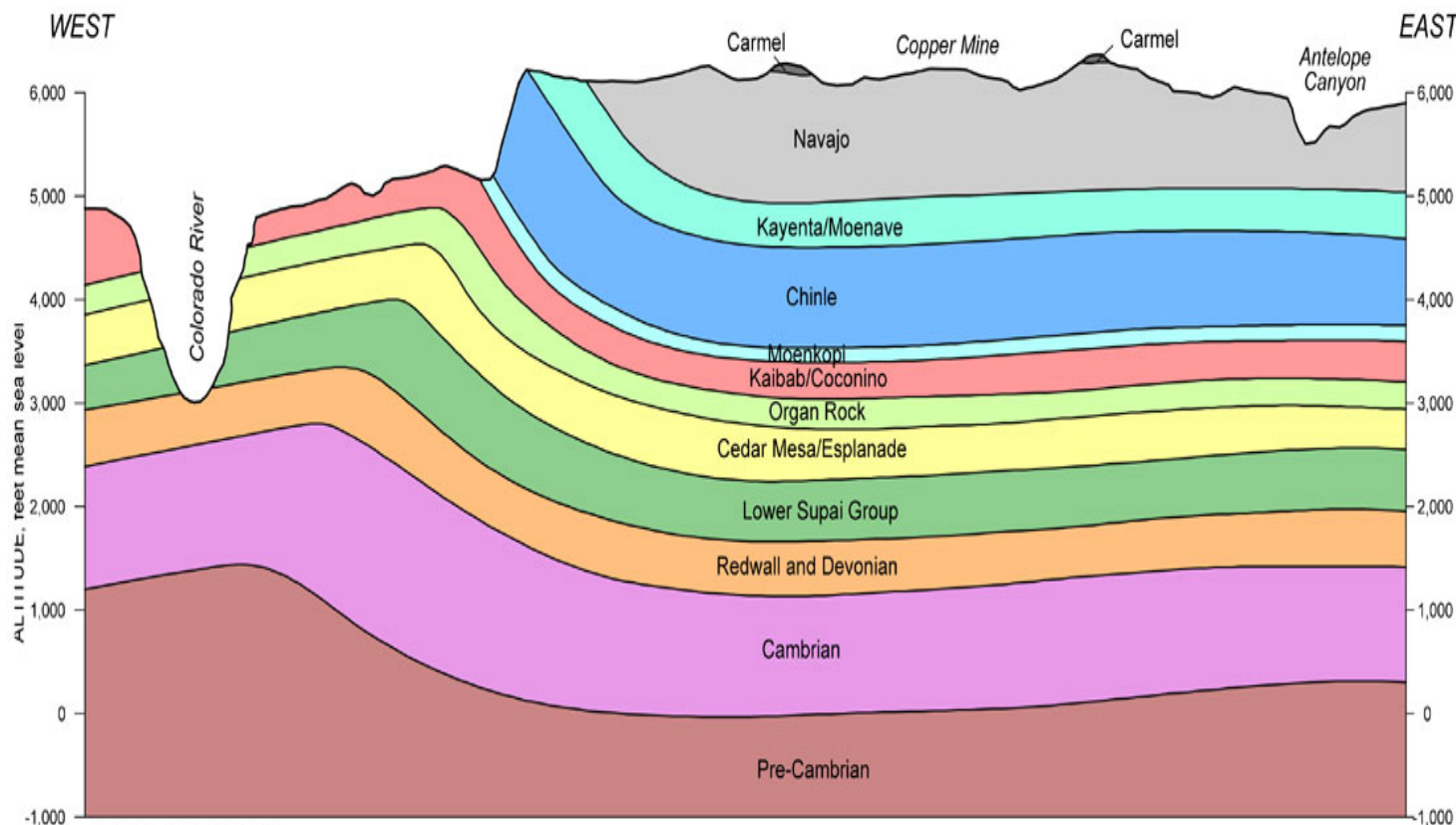
Schedule

	FY06		FY07		FY08		FY09	
Phase I								
Phase II								
Phase III								

Pilot Test Objectives

- Demonstrate the safety and feasibility of CO₂ storage in saline formations in the vast Colorado Plateau region in Arizona;
- Demonstrate and test methods for monitoring CO₂ storage projects in consolidated sandstones, shale and carbonate fields; and
- Gain experience with regulatory permitting and public outreach associated with CO₂ storage in a saline formation in Arizona.

Phase I. Assessing Options



Schematic showing the subsurface lithology in Northern Arizona. Potential storage formations include the Cedar Mesa Sandstone and the Redwall Limestone. In some areas, the Kaibab Limestone and Coconino Sandstone may also be suitable storage formations.

Potential Storage Formations and Seals

Table 1

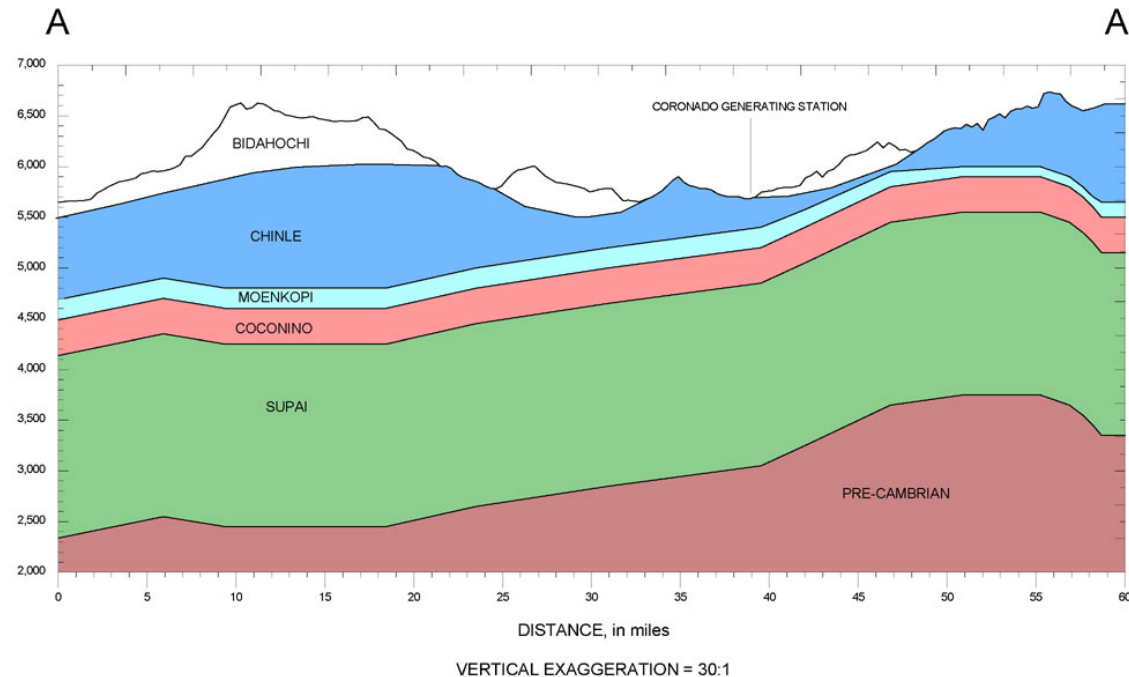
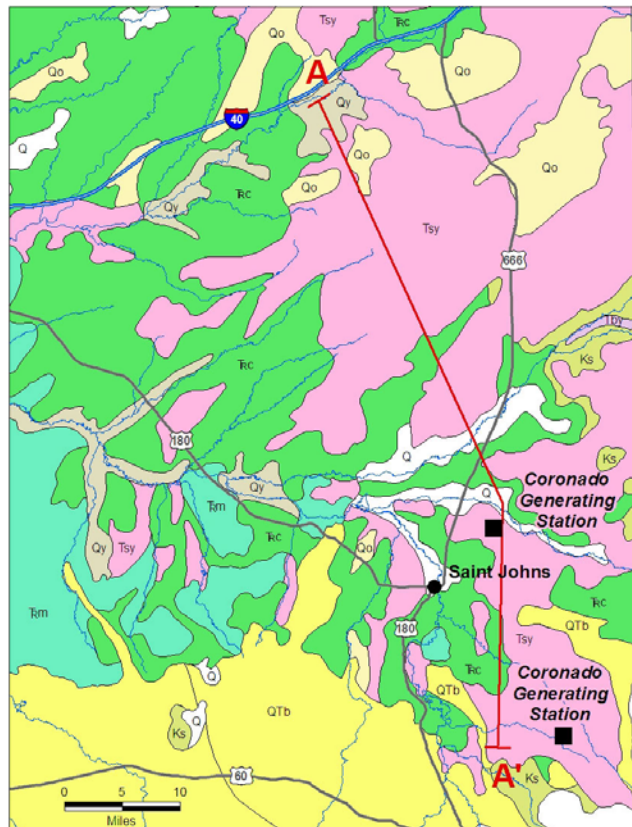
Formation	Top Elevation	Depth (ft)	Thickness(ft)
Chinle-Moenkopi	3825	525	1155
Kaibab Limestone	2670	1680	15*
Coconino Sandstone	2655	1695	555
Organ Rock Shale	2100	2250	455
Cedar Mesa Sandstone	1645	2705	1315
Redwall Limestone	-235	4585	545
Muav Limestone-Bright Angel Shale	-1525	5875	615
Tapeats Sandstone	-2140	6490	330**

*=Assumes Kaibab pinches out at Sinclair Oil well

**= Estimate, R. Allis Utah Geo. Survey

Potential storage reservoirs are indicated by the white color of the boxes, seals are indicated by gray shading. The water table in Northern Arizona can be up to 1,000 feet deep, making deeper storage targets more attractive options.

Assessing Options: Geologic Structure Near the Coronado Generating Station



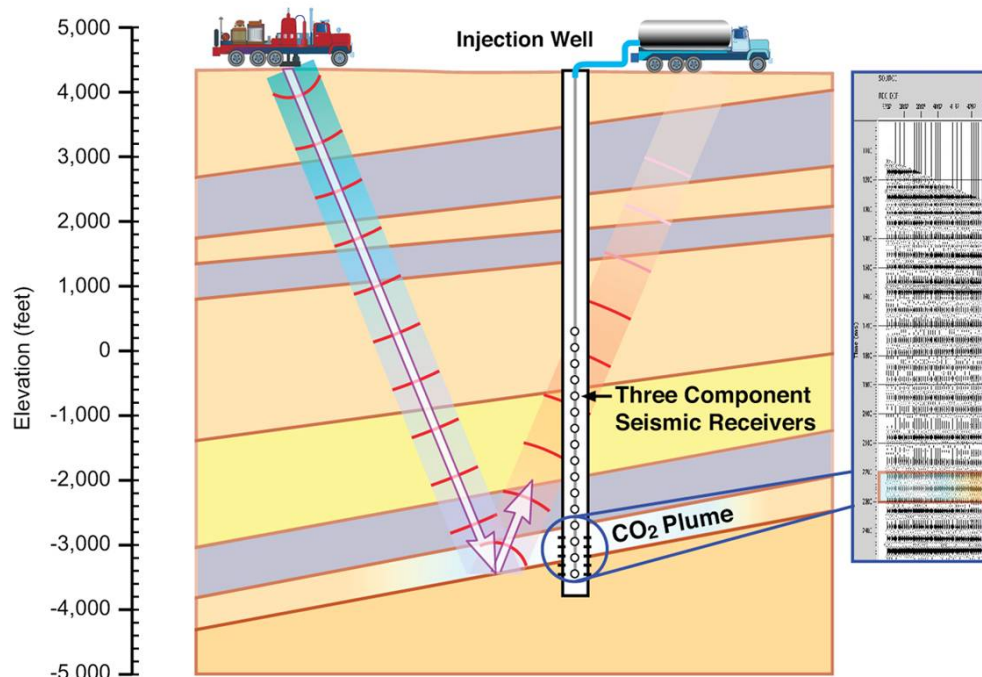
From Errol Montgomery and Associates 2006

Phase I. Public Outreach

- Meetings have been held with local regulators regarding the project.
 - Constructive interaction
 - Agreed to participate on an advisory committee for the project
 - Suggested members for advisory board
- An advisory committee for the project has been established and the first meeting has been held

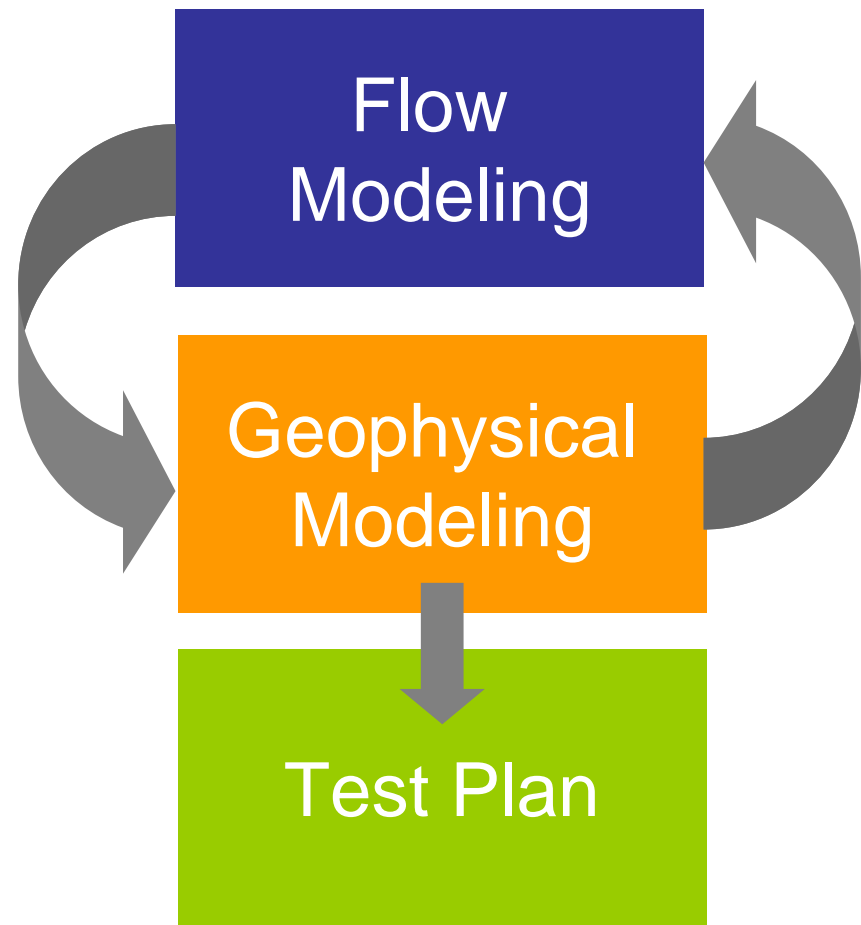
Phase II. Detailed Site Characterization

- Drill a single well
 - Geologic logs
 - Geophysical logs
 - Short term permeability tests of promising injection zones
- Assess most promising options for CO₂ storage test
- Assess regional storage potential



Phase III. CO₂ injection, monitoring and storage assessment

- CO₂ Injection
 - ~2,000 tonnes
 - Manufactured or natural source
- Monitoring
- Seal integrity assessment
- Injectivity assessment
- Capacity assessment



Phase III. Monitoring

Measurement technique	Measurement parameters	Application
Fluid composition	CO ₂ & natural gas composition Brine salinity, alkalinity, pH and composition	Predict solubility and mineral trapping Quantifying CO ₂ -water-rock interactions
Subsurface pressure	Reservoir pressure Overlying reservoir pressure Annulus pressure Groundwater aquifer pressure	Control of formation pressure below fracture gradient Wellbore and injection tubing condition Leakage out of the storage formation
Well logs	Gamma, SP, resistivity Brine salinity Sonic velocity CO ₂ saturation (RST)	Lithology Tracking CO ₂ movement in and above storage formation Tracking migration of brine into shallow aquifers Calibrating seismic velocities for VSP surveys
Vertical seismic profiling	P and S wave velocity Reflection horizons Seismic amplitude attenuation	Detecting detailed distribution of CO ₂ in the storage formation Detection leakage through faults and fractures
Cap rock integrity (if feasible)	Leakoff test	Natural stress state
CO ₂ land surface flux monitoring using flux chambers and eddy covariance	CO ₂ fluxes between the land surface and atmosphere	Detect, locate and quantify CO ₂ releases
Soil gas sampling	Soil gas composition Isotopic analysis of CO ₂	Detect elevated levels of CO ₂ Identify source of elevated soil gas CO ₂

Benefits to the Region

- Large and growing CO₂ sources
- Favorable geology for geological storage
- Assessment of CO₂ storage potential
 - Seal integrity
 - Injectivity
 - Capacity

